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# Study on the mass-cultivation technique of feed

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# STUDY ON
# THE MASS-CULTIVATION TECHNIQUE OF FEED

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S-44 No. 14 March, 1971

## TRANSLATER'S NOTE

* I have translated this article from Japanese to English as faithfully as possible.

* Names of shellfish in Japanese are spelled phonetically alongside their scientific names.

* Ambiguous words used by authors are quoted.

* Some of the printings in the graphs are not readable due to lightness of the ink.

# INTRODUCTION

Since 1965, research studies related to the mass-culture of feed, which is fundamental in the artificial seed-collection of bivalve, have been in progress. Somehow or in other ways, the required quantity of feed has become more positively known. Therefore, some changes are made this year following the course of our observations.

Rearing-tests of the free-swimming larvae of bivalves in different species were conducted with the use of feeds;

(1) feed which are becoming easily cultivated in large quantity.

(2) feed which can be easily obtained from manufacturer.

The effectiveness of the feeds and their problems were examined.

Among the feed tested experimentally were seeds of Green given by Mr. Hasegawa, a technician at the Setonaikai Culture Fishery Center, Okujima Branch.

Marine Yeast(sample material) was donated by Asahi Kasei Co. Adult Cho-se-n Ha-ma-gu-ri(Meretrix lamarckii Deshayea) were provided by Mr. Watanabe, the head of Culture Department at Ibaragi-Prefecture Fisheries Experimental Station. Adults were caught by the above organization. We would like to thank those mentioned above for their assistance.

## TESTING METHODS

1. Free-swimming larvae of bivalve used for the experiments.

Ho-ta-te Ga-i(Patinopecten yessoensis Jay)

Ho-k-ki Ga-i(Spisula sachalinensis Schrenck)

Fu-ra-n-su Ga-ki(Ostrea edulis L.)

Mu-ra-sa-ki Ga-i(Mytilus edulis L.)

Cho-se-n Ha-ma-gu-ri(Meretrix lamarckii Deshayes)

The spawning stage of the above outlined adults were induced by temperature-stimulation where artificial

fertilization took place. When the larvae reached the D-shaped stage, they were used for the experiment.

The D-shaped larvae were put into a triangle-shaped flask(3 litres) or into a chloride-vinyl water tank(20 litres) filled with filtered sea-water. During the period between the attachment and the benthic-stage, a standard culture-fluid were fed to the larvae and the growth-yields of the larvae were examined.

## 2. Feeds used for the experiment.

Chaetoceros calcitrans

Monochrysis lutheri

Phaeodactylum tricornutum

Green .....Seed unknown. Suspected to be Marine Chorella.

Marine Yeast ...Lot No. 110123P05F, spray dry-product.

In the following article, the above names will be abbreviated as:

Ch, Mc, Ph, Green, M.Y.

Ch, Mc, Ph and Green were cultivated "naturally" with the use of culture-fluid mentioned below. When they "nearly" approached the peak of propagation, they were used for the experiment.

Composition of the Culture-fluid

| | | | |
|---|---|---|---|
| $NaNO_3$ | 200g/litre | 1 ml | Sterlized by heat. |
| $Na_2HOP_4$ - 12 aq | 50g/litre | 0.5 ml | |
| $Na_2SiO_3$ - 5 aq | 1.5g/litre | 1 ml | |
| $P_6$ metals | | 1 ml | |
| Tris Buffer | *5.0g/litre | 2 ml | |
| Filtered Sea-water | | 1,000 ml | |

(*) PH was adjusted to 7.5 by HCI.

M.Y.(powder form) was weighed and used after dissolving with sea-water.

3. Quantity of ~~feed~~ food given.

By measuring the quantity of ~~feed~~ food used for the experiments, the following relationship were established.

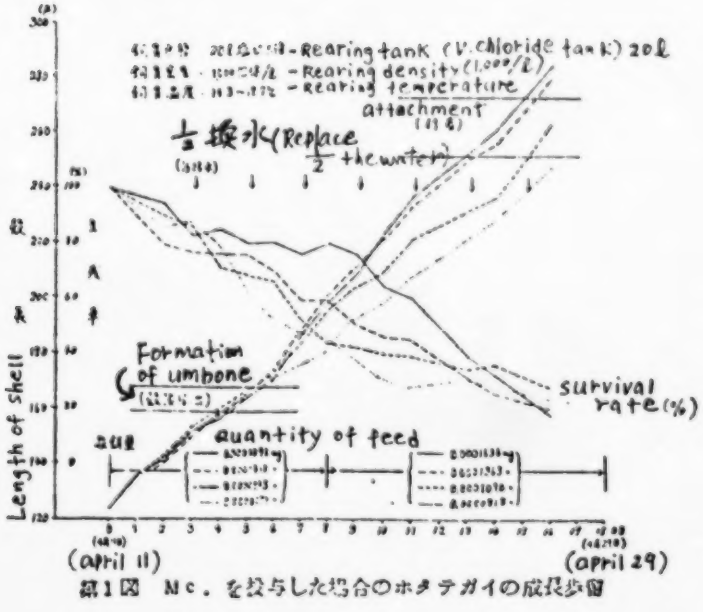
| Species | Dried-weight | Number of Cells | P.C.V |
|---|---|---|---|
| Ch. | 0.0000545 mg | = 4,500(individual) | = 0.000000678 ml |
| Mc. | 0.0000545 mg | = 2,000(individual) | = 0.000000121 ml |
| Ph. | 0.0000545 mg | = 4,950(individual) | = 0.000000256 ml |
| Green | 0.0000545 mg | =15,423(individual) | = 0.000000200 ml |
| M.Y. | 0.0000545 mg | ≒ 7,100(individual) | = |

Measurements of Ch, Mc, Ph and Green were easily obtained by cell counts. M.Y. was measured out by weight. Accordingly, daily feedings were carried out. To indicate the result of the tests, measurements of all ~~feeds were~~ food was converted into dry-weight.

## RESULTS OF THE EXPERIMENT

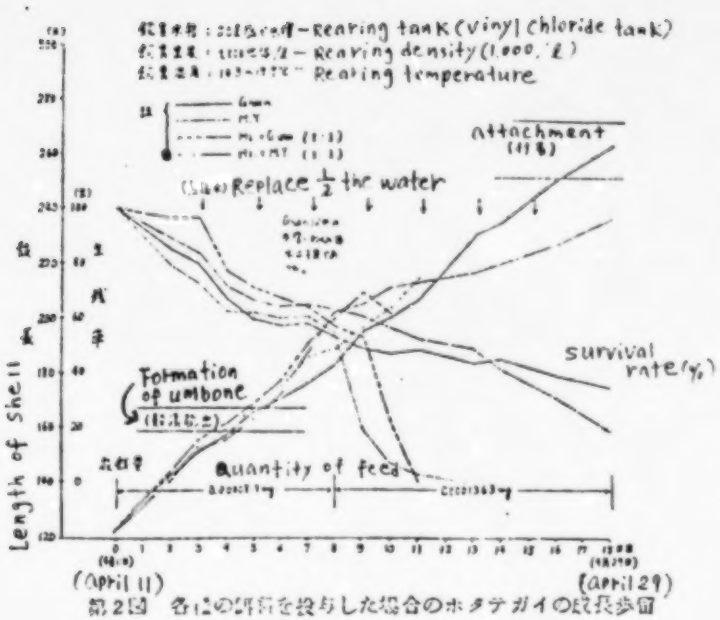
### 1. Ho-ta-te Ga-i(Patinopecten yessoensis Jay)

The results of the rearing and the summary of rearing conditions are shown in Fig. i and Fig. 2.




第1図 Mc. を投与した場合のホタテガイの成長歩留

Fig. 1 Growth-yields of Ho-ta-te Ga-i (Patinopecten yessoensis Jay) when Mc was given.




第2図　各種の餌料を投与した場合のホタテガイの成長歩留

Fig. 2　Growth-yields of Ho-ta-te Ga-i (Patinopecten yessoensis Jay) when different types of feed were given.

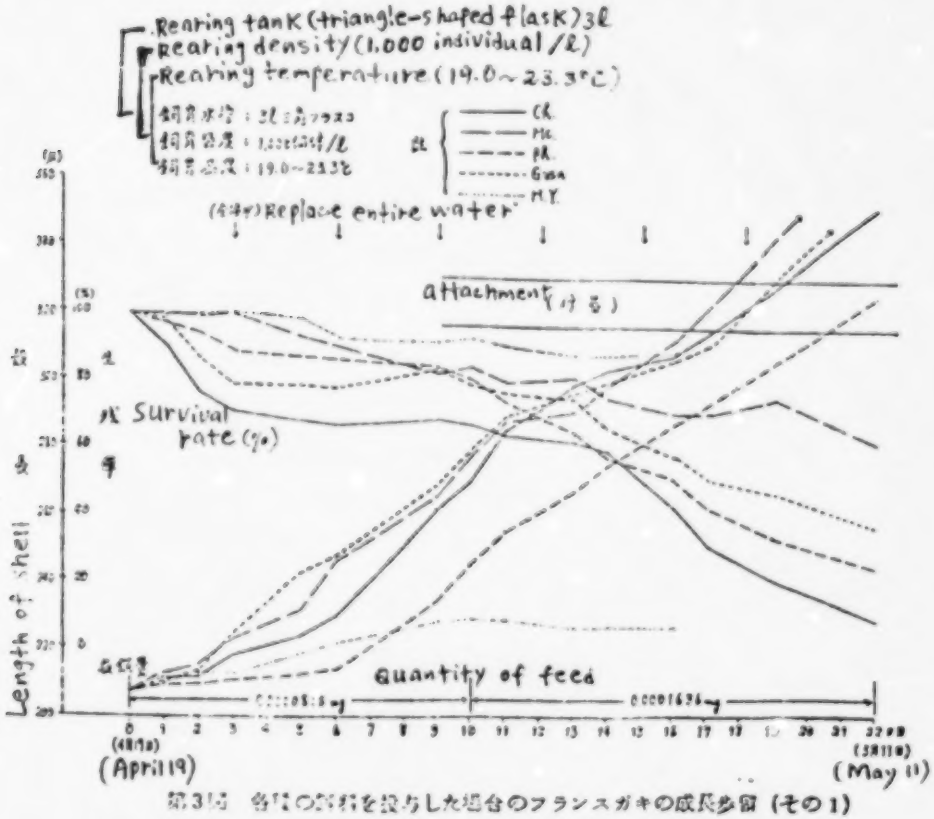
It appears that Mc is a favourable feed. In the beginning, 0.0000273 mg of Mc was required to feed one individual for a day, and around 0.0001636 mg for the period between the middle and later stage.

It is possible to rear larvae with Green up to the attachment-stage but larvae growth is delayed in comparison with the use of Mc.

In the beginning, the growth of the larvae with M.Y. equally matched Mc. However, the results of growth during the attachment-stage was marred by an accident during the experiment.

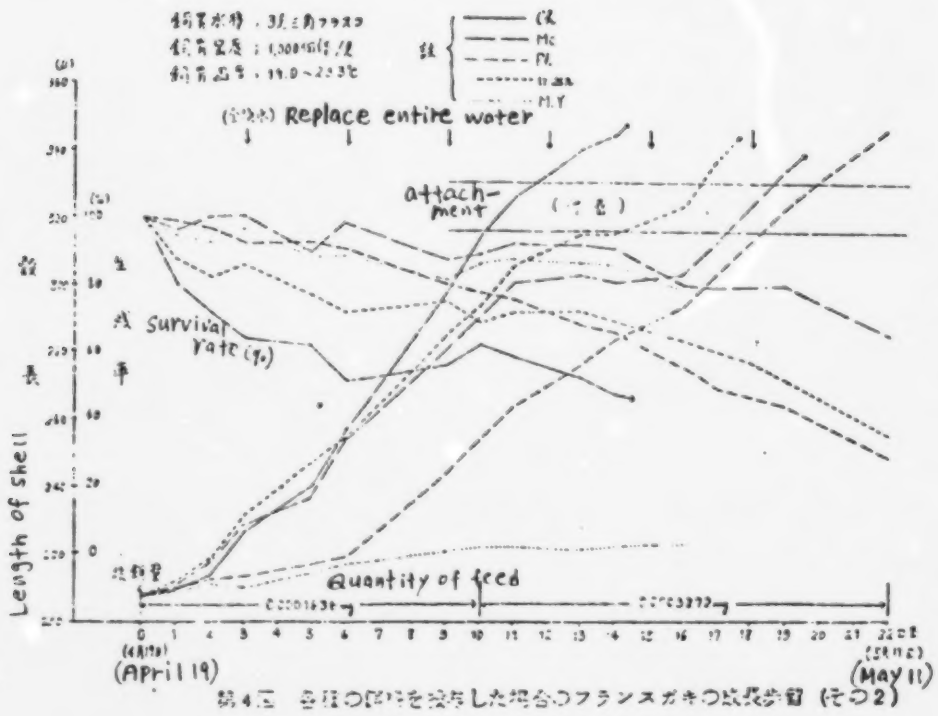
## 2. Fu-ra-n-su Ga-ki(Ostrea edulis L.)

The results of the experiment on Fu-ra-n-su Ga-ki are shown in Fig. 3 and Fig. 4.




第3図　各種の飼料を投与した場合のフランスガキの成長多量 (その1)

(Fig. 3) Growth-yields of Fu-ra-n-su Ga-ki (Ostrea edulis L.) when different types of feed were given. (No. I)




第4図　各種のえさを与えた場合のフランスガキの成長参照（その2）

Fig. 4　Growth-yields of Fu-ra-n-su Ga-ki (Ostrea edulis L.) when different types of feed were given. (No. 2)

Best growth is shown with Ch followed by Green, Mc and Ph in that order. It was possible to rear the larvae with Ch, Green, Mc and Ph until it has reached the attachment-stage.

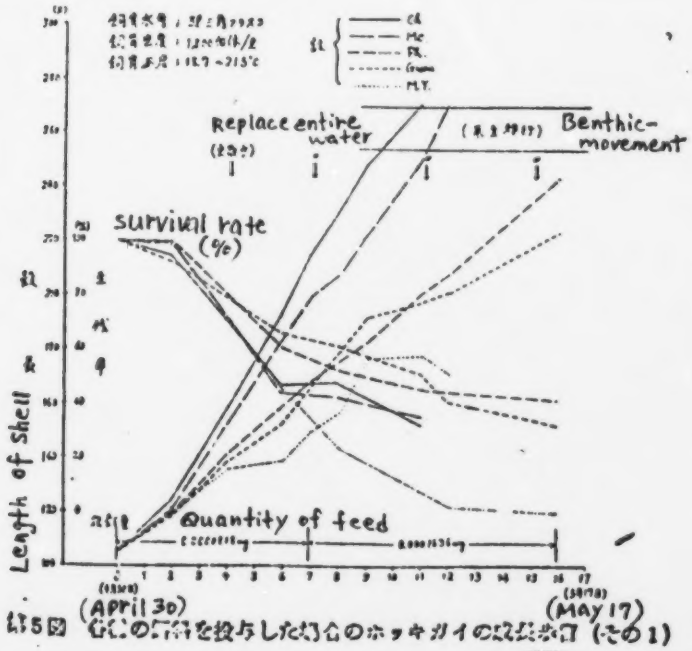
In any case, it is believed that around 0.0001636 mg of ~~food~~ Sea was required for one individual larvae per day

in the beginning, and around 0.0003372 mg for the later period.

When M.Y. was given to the larvae, no growth was shown. It is suspected that the feed effectiveness of M.Y. is "almost" nil.

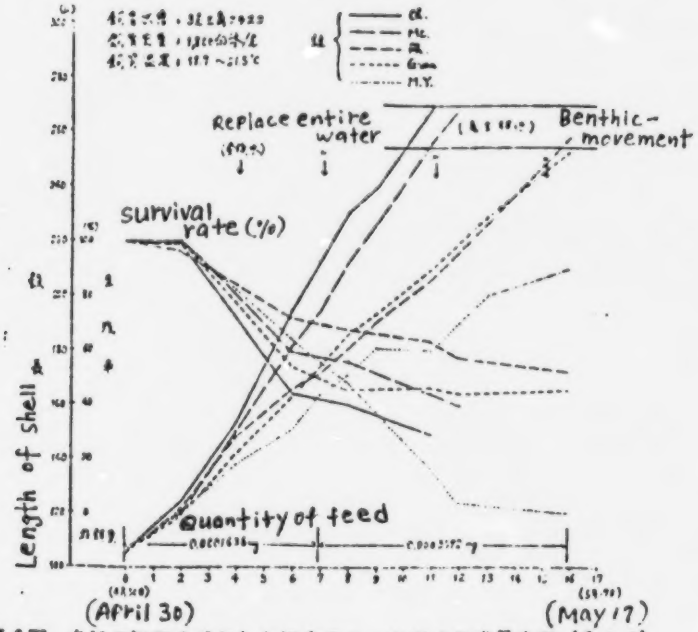
## 3. Ho-k-ki Ga-i (Spisula sachalinensis Schrenck)

The results of the experiment with Ho-k-ki Ga-i are shown in Fig. 5, Fig. 6 and Fig. 7.




第5図 なにの飼料を投与した場合のホッキガイの成長曲線 (その1)

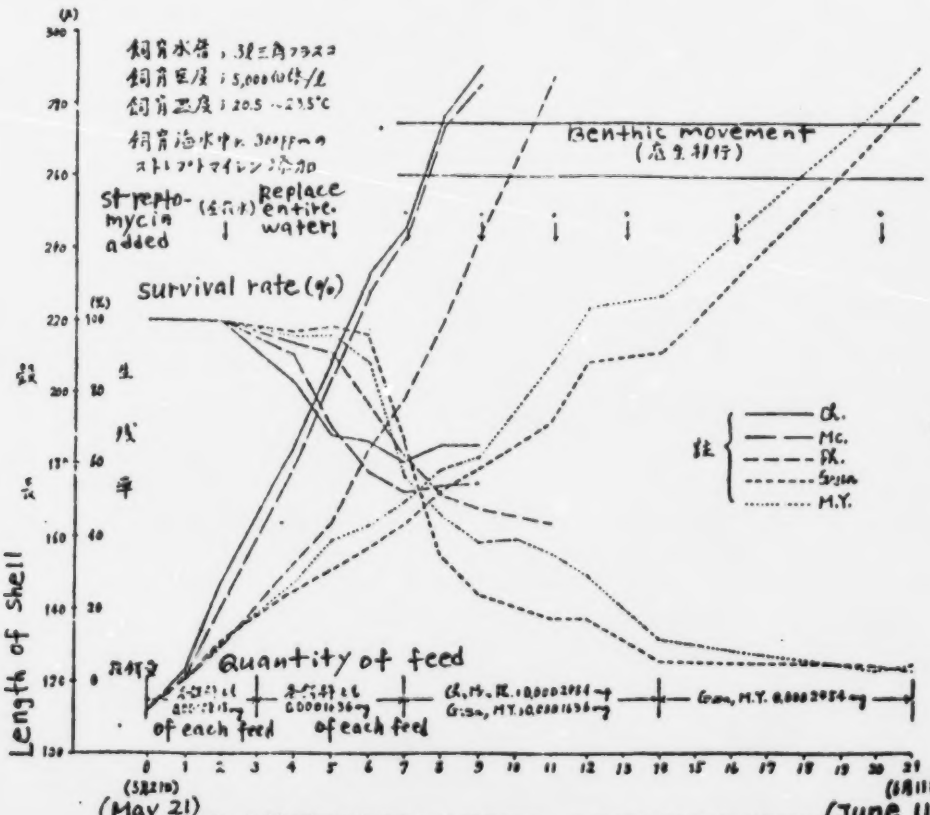
Fig. 5 Growth-yields of Ho-k-ki Ga-i (Spisula sachalinensis Schrenck) when different types of feed were given. (No. 1)




第6図 各種の飼料を投与した場合のホッキガイの成長歩留 (その2)

Fig. 6

Growth-yields of Ho-k-ki Ga-i (Spisula sachalinensis Schrenck) when different types of feed were given. (No. 2)




第7図 各種の飼料を投与した場合のホッキガイの成長歩留 (その3)

Fig. 7 Growth-yields of Ho-k-ki Ga-i (Spisula sachalinensis Schrenck) when different types of feed were given. (No. 3)

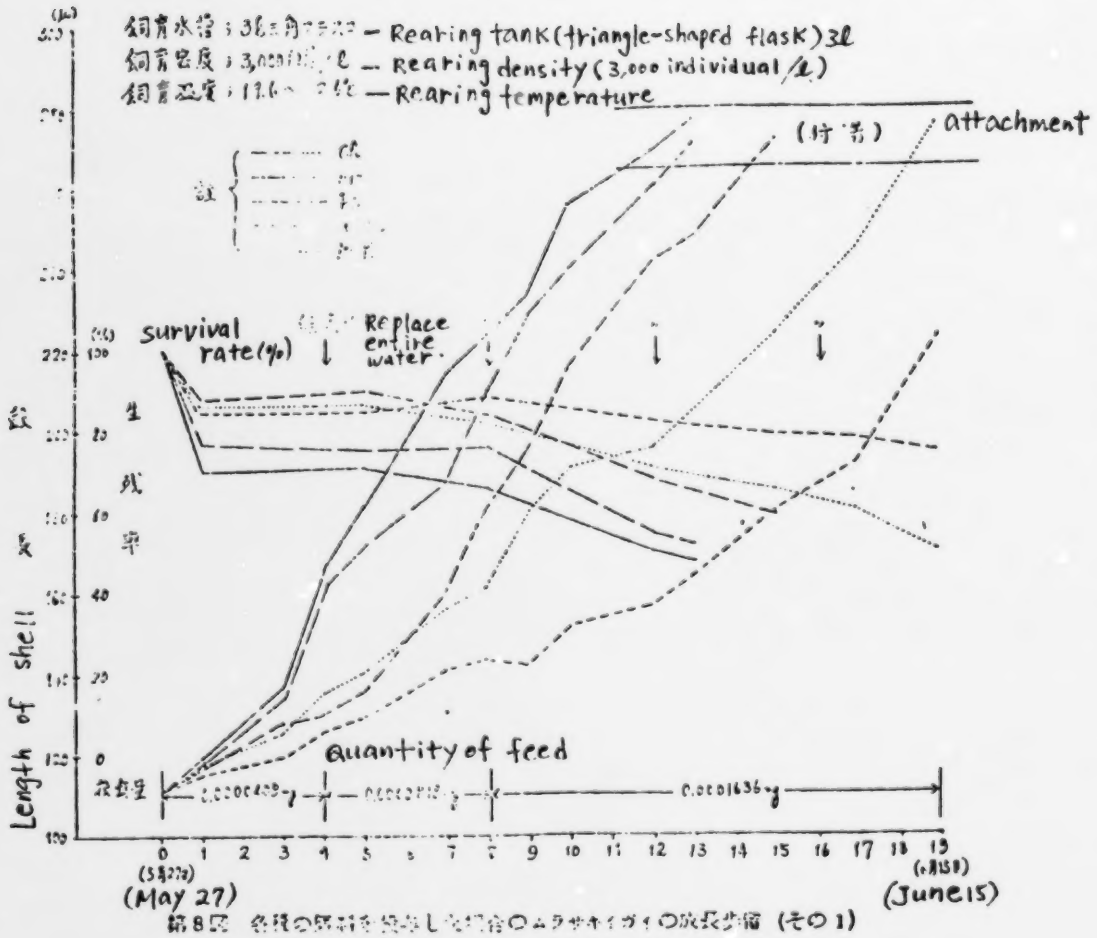
The result with Ch shows the best growth. The result with Mc is not as "bad". The growth is delayed with Ph and Green and the growth-yield was not favourable. However, some larvae managed to progress into the benthic-stage.

Growth and growth-yield is not favourable with M.Y. when the larvae were reared in the normal way. It was difficult to raise them during the period leading to the benthic-stage. However, when strepto-mycin was added to sea-water, some of the larvae survived to the benthic-stage.

0.0000818 mg is considered to be a sufficient quantity of feed per day for an individual larvae in the beginning through the mid-period of their growth, and 0.0001686 mg towards the later period.

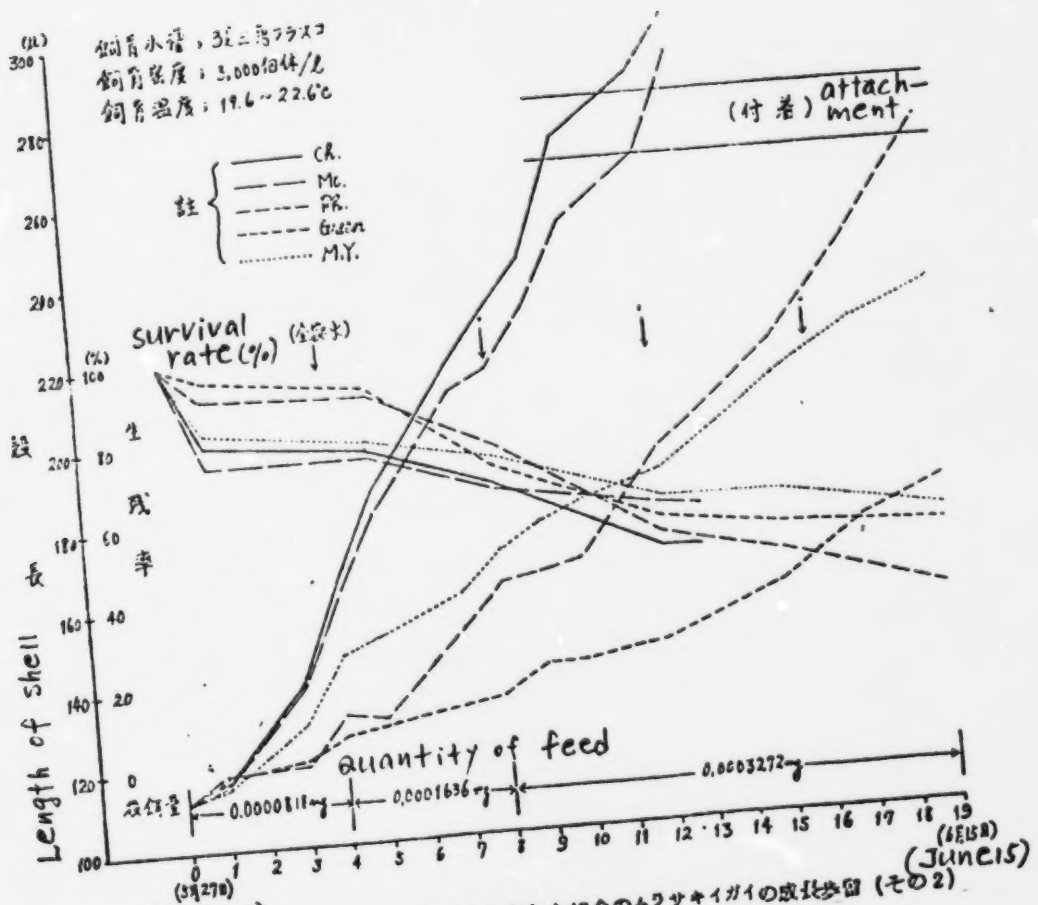
## 4. Mu-ra-sa-ki Ga-i(Mytilus edulis L.)

The results of the experiment with Mu-ra-sa-ki Ga-i are shown in Fig. 8 and Fig. 9.




第8図 各餌の与え方による場合のムラサキイガイの成長曲線 (その1)

Fig. 8 Growth-yields of Mu-ra-sa-ki Ga-i (Mytilus edulis L.) when different types of feed were given. (No. I)




第9図 各種の餌料を投与した場合のムラサキイガイの成長参留 (その2)

Fig. 9 Growth-yields of Mu-ra-sa-ki Ga-i (Mytilus edulis L.) when different types of feed were given. (No. 2)

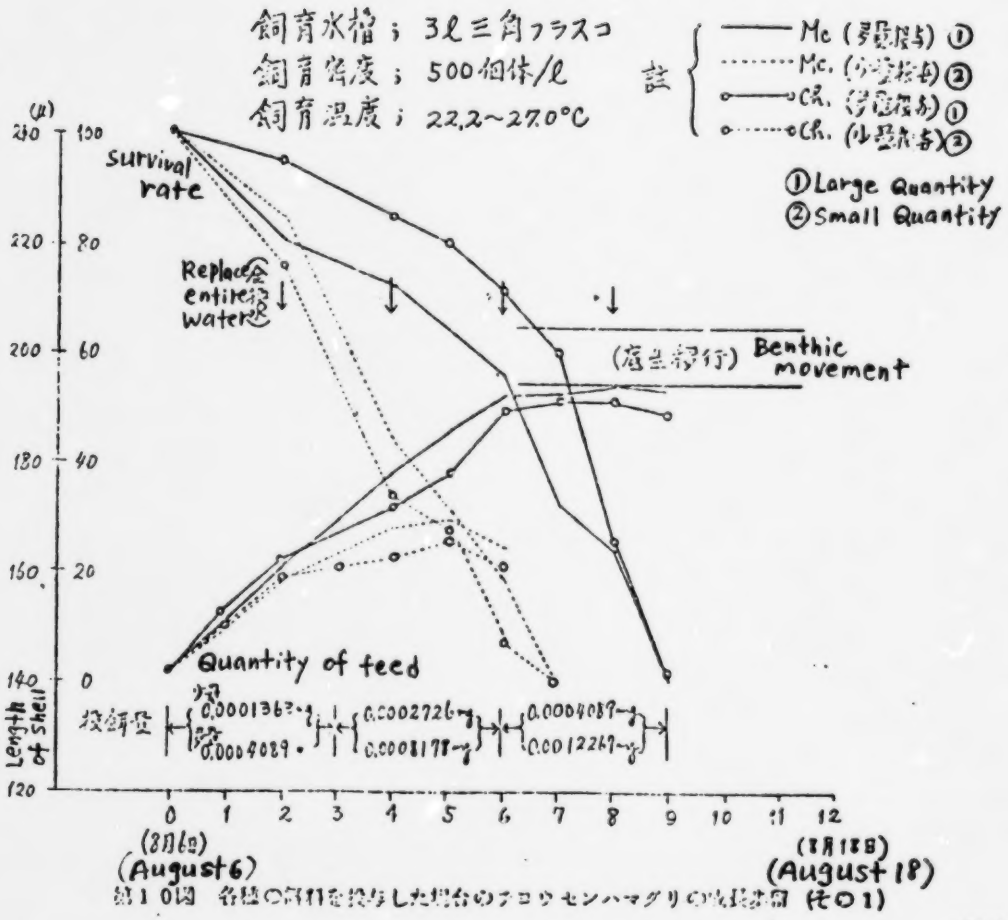
The results with Ch and Mc shows the best growth. The growth of larvae is effectively delayed with Ph and M.Y. but rearing up to the attachment-stage was possible.

The growth is very unfavourable with the use of Green and further the possibility of rearing the larvae to the attachment-stage is doubtful.

A quantity of 0.0000409 mg of Ch and Mc per day required for an individual larvae is believed to be sufficient in the beginning of its' growth, 0.0000818 mg in the mid-stage and 0.0001686 mg for the later stage. However, it appears that a greater quantity is required when Ph and M.Y. are used.

5. Cho-se-n Ha-ma-gu-ri(Meretrix lamarckii Deshayes)

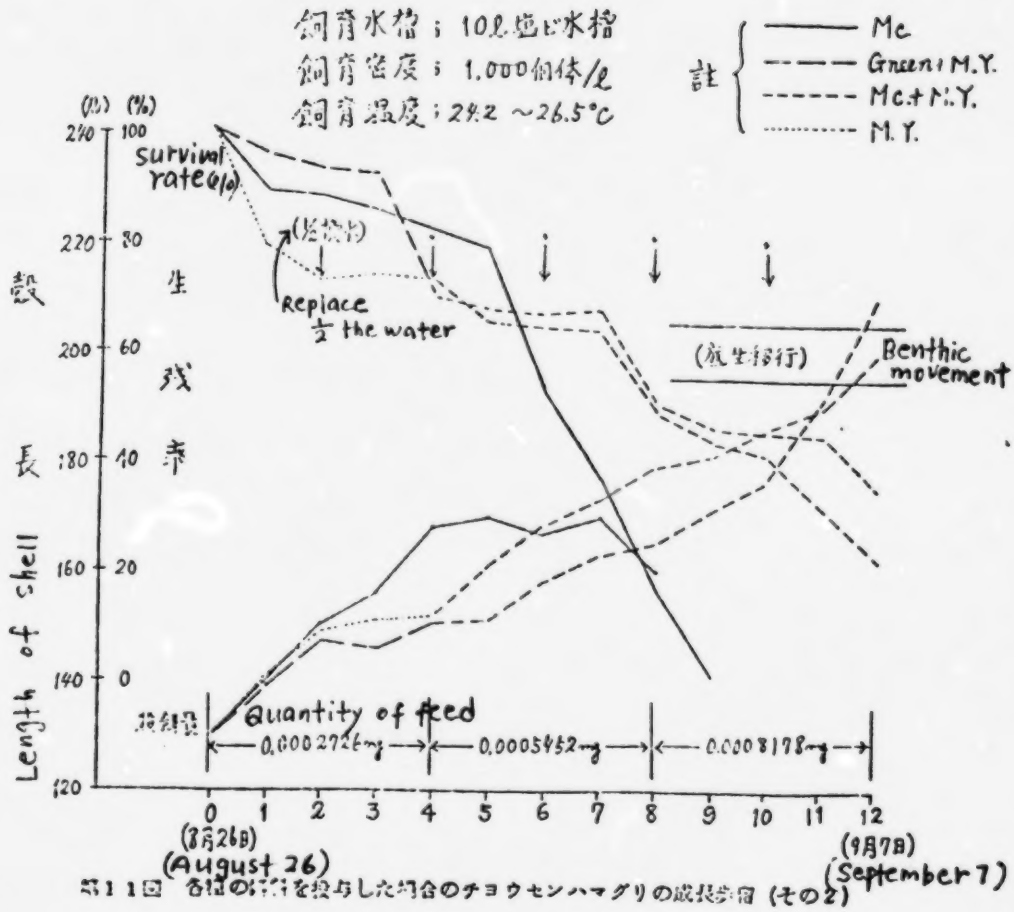
The results of the experiment with Cho-se-n Ha-ma-gu-ri are shown in Fig. 10 and Fig. 11.




第10図　各種の餌料を投与した場合のチョウセンハマグリの成長曲線（その1）

Fig. 10　Growth-yields of Cho-se-n Ha-ma-gu-ri (Meretrix lamarckii Deshayes) when different types of feed were given.

(No. 1)




第11図 各種の餌を投与した場合のチョウセンハマグリの成長量 (その2)

Fig. 11 Growth-yields of Cho-se-n Ha-ma-gu-ri (Meretrix lamarckii Deshayes) when different types of feed were given.

(No. 2)

It was possible to rear larvae up to the benthic-movement-stage when Ch, Mc and Green were fed individually. However, none of the larvae managed to survive into the benthic-stage due to metamorphosis. When the mixture of Mc and M.Y.( 1:1) were give, some larvae managed to transform into the benthic-stage.

The quantity of feed required is not too clear, but around 0.0002 - 0.0005 mg per day for an individual larvae is considered to be necessary during the period between the mid-stage and the later stages of growth.

It appears that additional quantity of feed is required to rear Cho-se-n Ha-ma-gu-ri(Meretrix lamarckii Deshayes).

## SUMMARY AND CONSIDERATIONS

A summary of the experimental results is shown in Table 1.

As Table 1 indicates, it has become clear that Ch and Mc, which have been widely used up to now to feed most bivalve species except Cho-se-n Ha-ma-gu-ri (Meretrix lamarckii Deshayes), showed the most favourable response and effectiveness in feeding without any exception.

① Patinopecten yessoensis Jay ② Ostrea edulis L.
③ Spisula sachalinensis Schrenck ④ Mytilus edulis L.
⑤ Meretrix lamarckii Deshayes

第1表 各種の餌料を用いて飼育した場合の二枚貝浮遊幼生の定着日数と歩留

| | Hotate Gai ①ホタテガイ | Furansu GaKi ②フランスガキ | Hokki Gai ③ホッキガイ | murasaki Gai ④ムラサキイガイ | Chosen Hamaguri ⑤チョウセンハマグリ |
|---|---|---|---|---|---|
| Ch. | — | 60% / 11日 = 5.5 | 65% / 8日 = 8.2 | 55% / 10日 = 5.5 | 0% / × = 0 |
| Mc. | 36% / 15日 = 2.5 | 78% / 17日 = 4.6 | 55% / 8日 = 6.9 | 55% / 13日 = 4.2 | 0% / × = 0 |
| Ph. | — | 45% / 19日 = 2.4 | 50% / 16日 = 3.1 | 54% / 15日 = 3.6 | — |
| Green Green | 35% / 19日 = 1.9 | 66% / 15日 = 4.4 | 40% / 17日 = 2.4 | 0% / × = 0 | — |
| M. Y. | 幼期の成長良好 | 0% / × = 0 | 3% / 19日 = 0.2 | 52% / 19日 = 2.7 | 0% / × = 0<br>Mc. と併用した場合<br>35% / 12日 = 2.9 |

(注) 上段 ; 定着時の歩留。
下段 ; 定着までに要した日数。
上段を下段で除して得た値; 一般にこの値が高い程餌料は効果が高いと見做すことが出来。

Table 1 Number of days required to attain the attachment-stage and the growth-yields of free-swimming bivalve larvae with different types of feed.

(Note) Top ..... Growth-yields up to the attachment-stage.

Bottom .. Number of days required to reach the attachment-stage.

Top-figure is divided by Bottom-figure:
In general, a larger the number is, the higher is the effectiveness of the feed.

It is our hope that further investigation on the Cho-se-n Ha-ma-gu-ri(Meretrix lamarckii Deshayes) should be reconsidered since this was our first experiment with this species and best results could not be obtained with inexperience of handling.

It appears that Ph, which can be cultivated easily in large quantities in comparison with Ch and Mc, perhaps in general delays the growth of the larvae but growth-yields with Ph is not "bad". Feeding of Ph seems to be rather effective.

By combining Ph with Ch and Mc, which are both difficult to cultivate in large quantities, there may be practical ways of obtaining this feed easily. It is our intention to conduct further studies.

Followed by Ph, Green is also a species that can be easily cultivated in quantity. This ~~feed~~ food is highly effective on Fu-ra-n-su Ga-ki(Ostrea edulis L.) but responses from other bivalves is not too favourable.

A merit of M.Y. is that it can be produced in the factory; furthermore, can be stored in a dry form. Feed tests with Mu-ra-sa-ki Ga-i(Mytilus edulis L.), Ho-ta-te Ga-i(Patinopecten yessoensis Jay) and Cho-se-n Ha-ma-gu-ri(Meretrix lamarckii Deshayes) appears encouraging.

Therefore, further studies on the usage of M.Y. should be pursued and it is our hope to capitalize on its' potential.

## THE REMAINING PROBLEMS AND COURSE OF SOLUTION

It appears that there are two types of ~~feed~~ food available in rearing bivalves ~~from~~ for artificial seed-collection. Among them are marine phyto-planktons cultivated in large quantities and marine yeasts which can be purchased as a finished product.

We "believe" that we have acquired some general knowledge about marine phyto-planktons. The effectiveness of manufactured feed on collected-seeds can not be fully determined. However, to be quite effective, it must be put into good use. This ~~feed~~ food has a high rating as a ~~feed~~ food, and is easily obtainable. In the future, we would like to conduct many more detailed studies on the subject and to apply it practically.

We wish to give priority to the above points and

to continue studies on such designated project -- Technical Study on Seed Production -- under the direction of the Aomori-Prefecture Fish Culture Centre.

Translated by Minori Miki

November, 1982

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